Overview of NETL Field Studies Related to Oil and Gas Production

DOE Tribal Leaders Forum
Denver, Colorado

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Program Objectives

- Reduce Environmental Impacts
- Demonstrate Safe/Reliable Operations
- Improve Efficiency of Hydraulic Fracturing
Monitoring of Oil and Gas Operations

- **Surface Monitoring**
  - Ambient Air Quality
  - Air Emissions
  - Ground Motion
  - Surface Water

- **Near-Surface Monitoring**
  - Spills and Leaks
  - Well-Bore Integrity
  - Abandoned Wells

- **Sub-Surface Monitoring**
  - Fracture Growth
  - Fluid/Gas Migration
Surface Monitoring - Air Quality

Ambient Air Monitoring Laboratory

Measures air contaminants relevant to oil and gas exploration and production:

- VOC's
- CH₄ and CO₂ w/isotope speciation
- Ozone
- NOₓ (NO, NO₂ and NO+NO₂)
- Organic/Elemental Carbon in Aerosols
- Ammonia
- Radon
- PM₂.₅ and PM₁₀
- SO₂
- Meteorological station
Surface Monitoring- Air Emissions

Methane Emissions
- Unconventional Well Development
  - Drilling
  - Hydraulic Fracturing
  - Flowback
  - Production
- Abandoned Wells
- Compressors
- Pipelines
  - Gathering
  - Transmission
Surface Monitoring - Ground Motion

Ground Motion - Hydraulic Fracturing
1. **Surface above Marcellus Wells**
2. Underground Document Repository

[Diagram showing a map with markers labeled A to F and UD-1 to UD-7, indicating a network of points and connections.]
Surface Monitoring - Ground Motion

**Background**

**During Frac**
Surface Monitoring- Ground Motion
Surface Monitoring - Ground Motion

Ground Motion - Hydraulic Fracturing
1. Surface above Marcellus Wells
2. Underground Document Repository

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Surface Monitoring - Water Quality

Surface Water

1. Water Quality
2. Water Quantity
3. Erosion and Sedimentation
Near-Surface Monitoring

Spills and Leaks
1. **Airborne Electromagnetic Surveys**
2. Ground Electromagnetic Surveys
Near-Surface Monitoring

Spills and Leaks
1. Airborne Electromagnetic Surveys
2. **Ground Electromagnetic Surveys**
3. Groundwater Monitoring
Near-Surface Monitoring

Spills and Leaks
1. Airborne Electromagnetic Surveys
2. Ground Electromagnetic Surveys
3. **Groundwater Monitoring**
Near-Surface Monitoring

Wellbore Integrity

1. Man-Made Tracers
Near-Surface Monitoring

 Locating Abandoned Wells
 1. Airborne Magnetic Surveys
 2. Ground Magnetic Surveys

Airborne Magnetic Survey

Map of Well-Type Magnetic Anomalies

Navigating to Magnetic Anomaly Location

Locating Magnetic Anomaly on the Ground

Excavation to Confirm Well Location
Sub-Surface Monitoring

Fracture Growth
1. Microseismic Monitoring
2. Cross-Well Seismic Tomography
Sub-Surface Monitoring

Fracture Growth
1. Microseismic Monitoring
2. Cross-Well Seismic Tomography
Cross-Well Seismic Tomography
Sub-Surface Monitoring

Fluid/Gas Migration
1. **Pressure/Production History**
2. Natural Gas Isotopes
3. Produced Water Isotopes
4. Man-Made Tracers
Sub-Surface Monitoring

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Graph showing δ13C-CH₄ over time for different wells.
Sub-Surface Monitoring

Fluid/Gas Migration
1. Pressure/Production History
2. Natural Gas Isotopes
3. **Produced Water Isotopes**
4. Man-Made Tracers

![Diagram showing mixing of produced waters and variability in total vertical depth and monitored interval.](chart.png)
Sub-Surface Monitoring

**Fluid/Gas Migration**

1. Pressure/Production History
2. Natural Gas Isotopes
3. **Produced Water Isotopes**
4. Man-Made Tracers
Sub-Surface Monitoring

Fluid/Gas Migration
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